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AD

PRODUCTION ENGINEERING MEASURE
for
TYPE CR-(XM-57)/U CRYSTAL UNITS
SEVENTH QUARTERLY REPORT

Prepared By
U.S. Army Electronics Command
Philadelphia, Pennsylvania

Oct 1967 to December 1967

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attn: AMSEL-KI-SP.

ECOM

UNITED STATES ARMY ELECTRONICS COMMAND · FORT MONMOUTH, N.J.

CONTRACT NO. DA-36-039-AMC-06182(E)
ORDER NO. FR-36-039-N-6-01409(E)

THE BULOVA WATCH COMPANY
ELECTRONICS DIVISION
61-20 Woodside Avenue
Woodside, New York

28

SEVENTH QUARTERLY REPORT

October 1967 to December 1967

Production Engineering Measure For
Type CR-(XM-57)/U Crystal Units

Order No. FR-36-039-N-6-01409 (E)
Contract No. DA-36-039-AMC-06182 (E)

Placed by:	U.S. Army Electronics Command Philadelphia, Pennsylvania
With:	The Bulova Watch Company Electronics Division 61-20 Woodside Avenue Woodside, N.Y.
Object of Study:	Prepare for quantity production, under controlled conditions, on the CR-(XM-57)/ Precision Crystal Units
Prepared by:	S. Cohen Project Director

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I ABSTRACT

Results obtained from the "Group 2" and "Group 3" environmental testing per MIL-C-39020 are presented.

II PURPOSE

To establish a design for CR-(XM-57)/U Crystal Units which will be adaptable to moderate and large quantity production. To establish overall test and measurement techniques for these units including the setup of aging test and measuring equipment, to prepare a Q. C. Manual covering these techniques as adapted to our pilot line. To establish pilot line equipment and the flow of material. To make a production type run to demonstrate the capability of the pilot line to fabricate 800 units per month meeting the applicable specification per 8 hour shift. To make a complete aging and reliability study of these units.

Crystals Under Study

Items	Nominal Frequency	Type	Quantities		
			Engineering	Preproduction	Production
1-2-1	5.000000 MC	CR-(XM-57)/U	12	10	200
1-2-2	6.000000 MC	CR-(XM-57)/U	12		200
1-2-3	7.500000 MC	CR-(XM-57)/U	12	10	200
1-2-4	9.000000 MC	CR-(XM-57)/U	12		200
1-2-5	10.000000 MC	CR-(XM-57)/U	12	10	200

III - Narrative

A. Completion of Environmental Testing of the Preproduction Units

The purpose of this report is to record the progress made during the seventh quarterly interval of the project. This period was devoted to the completion of the pre-production testing. Group 3 and Group 4 Testing of Table III of MIL-C-39020 were done at this time.

As reported in the last quarterly report, the only exception to the military specification has been in regards to sample size. Due to the limited number of pre-production samples (30) it was decided to place twenty units through "Group 1" testing, seven of the 5 MHZ units, seven of the 7.5 MHZ units and six of the 10 MHZ units. Of these twenty units, ten of them (3 at 5 MHZ, 3 at 7.5 MHZ, and 4 at 10 MHZ) were placed into "Group 2" testing for evaluation along with the remaining ten units.

The other ten units having been exposed to "Group 1" testing were subjected to "Group 3" testing. All thirty units were then subjected "Group 4" testing which is the life test.

The data collected shall now be presented in the order listed in the applicable military specification

B. Data

1. "Group 3" Testing

a. Thermal Shock - units were subjected to an immersion in boiling water for 15 ± 1 seconds and immediately thereafter in ice water for 5 ± 1 second.

The units were then placed under a strong light and exposed to ten power magnification. All glass parts were then carefully examined. In no instance was there evidence of cracking, chipping, or breaking in any part of the crystal units. Measurements were then taken r frequency and Q at 85°C. Results of this test are presented in Table I.

TABLE I

Crystal Parameter - Data

Results of Thermal Shock Testing

5.000000 MC

Freq. at + 85° C After Thermal Shock (cps)	Q at +85° C After Thermal Shock
5.000022	1,037,000
5.000001	1,070,000
5.000007	1,006,000
5.000000	1,020,000

7.500000 MC

7.499970	1,030,000
7.500018	1,050,000
7.500034	1,050,000
7.499989	1,027,000

10.000000 MC

10.000033	1,020,000
10.000017	1,043,000

Requirements - The frequency and Q shall be within the frequency tolerance (±.0005% at 85°C) and minimum Q (1,000,000) requirements

C_L = 50pf ± .5pf Drive level 2.0 ± 50% microwatts

b. Salt Spray - The crystal units were tested in accordance with method 101, test condition B, of MIL-STD-202.

After the test, the units were visually examined for evidence of excessive corrosion. There was no evidence of excessive corrosion visible. Excessive corrosion was construed as any type of corrosion that will interfere in any way with the electrical or mechanical performance of the units. Measurements were then taken for frequency and Q at 85° C. Results of this test are presented in Table II.

TABLE II

Crystal Parameter Data

Results of Salt Spray Testing

5.000000 MC

Freq. at +85°C After Salt Spray (cps)	Q at 85° C After Salt Spray
5.000024	1,030,000
5.000002	1,065,000
5.000007	1,010,000
5.000002	1,020,000

7.500000 MC

7.499969	1,030,000
7.500015	1,035,000
7.500034	1,040,000
7.499990	1,020,000

10.000000 MC

10.000032	1,010,000
10.000017	1,043,000

Requirements - The frequency and Q shall be within the frequency tolerance (±.0005% at 85°C) and minimum Q (1,000,000) requirements

C_L = 50pf ±.5pf Drive level 2.0 ± 50% microwatts

c. Moisture Resistance - Crystal units were tested in accordance with method 106 of MIL-STD-202. The following details and exceptions were applied as per paragraph 4.7.13 of MIL-C-39020.

(a) Initial Measurements - Not applicable

(b) Subcycle, step 7b, the vibration subcycle, shall be omitted

(c) Polarization and loading voltage - Not applicable

(d) Final measurements - After the drying period, frequency, equivalent resistance, and insulation resistance shall be measured.

Insulation resistance was measured in accordance with method 302 of MIL-STD-202, using a test potential of 50 volts. The measurement was made between the pins.

All of the units tested exhibited an insulation resistance more than the requirement specified in paragraph 3.21 of MIL-C-39020 (500 megohms). Measurements were then taken for frequency and Q at 85° C. Results of this test are presented in Table III.

TABLE III

Crystal Parameter Data

Results of Moisture Resistance Testing

Freq. at +85°C After M.R. (cps)	Q at +85°C After M.R.
5.000000 MC	
5.000022	1,037,000
5.000001	1,075,000
5.000008	1,024,000
5.000001	1,024,000
7.500000 MC	
7.499968	1,026,000
7.500016	1,030,000
7.500033	1,035,000
7.500088	1,015,000
10.000000 MC	
10.000034	1,020,000
10.000018	1,040,000

Requirements - The frequency and Q shall be within in frequency tolerance (±.0005% at 85° C) and minimum Q (1,000,000) requirements. The insulation resistance shall not be less than 500 megohms.

C_L = 50pf ± .5pf Drive level 2.0 ± 50% microwatts

d. Terminal Pull - The crystal units were tested in accordance with method 211, test condition A, of Standard MIL - STD-202. A force of 4 pounds were applied to the pin terminals of each crystal unit.

Each terminal withstood the applied pull force, without any of damage or relative movement at the point of sealing between the terminals and the base.

e. Seal - Crystal units were subjected to three heat cycles, each cycle consisting of the following; the temperature of each unit was raised to + 100° C for thirty minutes, then allowed to cool to room temperature at a rate not exceeding 2° C per minute.

Twenty-four hours after the heat cycling took place an energized Tesla Coil was brought into proximity of each unit. All exhibited the characteristic blue glow of a vacuum seal. The units were then placed under a strong light and exposed to ten power magnification. All glass parts were then carefully examined. In no instance was there evidence of cracking, chipping, or breaking in any part of the crystal units.

2. "Group 4" Testing

a. Life Test (1,000 hours) - The units were stored at a temperature of 85° C in the reliability test ovens for a continuous period of 1,000 hours. Measurements of frequency and resistance were made at the following intervals: 24 hours, 100 hours, 250 hours, and 500 hours and 1,000 hours. Results of this test are presented in IV, V and VI.

TABLE IV

Crystal Parameter Data

Results of Life Test

5.000000 MC

S/N	Deviation 24 hrs. to 100 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 100 hrs. @ 85°C ΔR. %	Deviation 24 hrs. to 250 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 250 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 500 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 500 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 1000 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 1000 hrs. @ 85°C ΔR %
500	+2	0	+5	+1	+7	+3	+8	+2
501	+3	+2	+7	+2	+9	+2	+11	+1
502	-5	+1	-3	+2	-1	+2	+3	0
503	-5	+1	-2	0	-4	+1	-8	-1
504	+4	0	+8	-1	+10	-1	+7	+1
505	-2	0	0	+1	+1	+1	+4	+2
506	-3	-1	+1	0	+3	-1	+7	-3
507	+2	0	+7	-1	+9	+1	+13	+3
508	-6	-1	-9	+1	-5	+2	-1	+2
509	+9	0	+13	+2	+14	+2	+17	+2

Note: The following units were subjected to the 500 hour aging test prior to the life test.
S/N 500, 501, 502, 503, 504, 505, 506

TABLE V

Crystal Parameter Data

Results of Life Test

7.5000000 MC

S/N	Deviation 24 hrs. to 100 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 100 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 250 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 250 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 500 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 500 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 1000 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 1000 hrs. @ 85°C ΔR %
700	+2	0	+4	0	+2	+1	+5	+2
701	+6	-2	+8	-3	+9	0	+7	+2
702	+1	+1	+3	+2	+4	+3	+6	+3
703	-1	+1	+2	+1	+4	+3	+5	+2
704	-3	+1	-6	+1	-4	+1	-3	+2
705	-5	+2	-3	+1	0	+2	-1	+2
706	+4	0	+6	-1	+7	+1	+9	+1
707	+3	0	+7	+1	+10	+1	+8	+3
708	+5	-1	+10	+1	+14	+2	+12	+3
709	+6	-1	+11	0	+13	+2	+17	+2

Note: The following units were subjected to the 500 hour aging test prior to the life test.
S/N 700, 701, 702, 703, 704, 705, 706.

TABLE VI

Crystal Parameter Data

Results of Life Test

10.000000 MC

S/N	Deviation 24 hrs. to 100 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 100 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 250 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 250 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 500 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 500 hrs. @ 85°C ΔR %	Deviation 24 hrs. to 1000 hrs. @ 85°C ΔF PP 10^{-8}	Deviation 24 hrs. to 1000 hrs. @ 85°C ΔR %
100	+3	+2	+6	+2	+5	+2	+15	+7
101	-1	+1	+2	0	+3	+2	+ 5	+2
102	+3	0	+3	+2	+6	+3	+ 7	+2
103	-3	0	-5	0	-1	-3	0	+1
104	-1	+1	-4	+2	-1	-1	+ 3	+3
105	+1	-1	+4	+1	+6	+4	+ 7	+2
106	+4	-2	+7	-1	+9	+1	+12	-1
107	+4	-1	+7	0	+11	+1	+14	0
108	+1	+2	+3	+1	+4	+2	+ 7	0
109	+5	+1	+7	+1	+10	-1	+15	+1

Note: The following units were subjected to the 500 hour aging test prior to the life test.
S/N 100, 101, 102, 103, 104, 105

TABLE VII

C. Equipment Used

Nomenclature	Manufacture/Model	Use
Reliability Oven	Winslow Tele-Tronics Model #PTO-1045	Life Test
Capacitance Bridge	Boonton, 74C	Measurement of Shunt Capacitance
Crystal Impedance Meter TS-330	Radio Frequency Labs Model 459	Oscillator
High Temperature-Low Temperature Humidity Test Chamber	Associated Testing Lab Model ELHH-8-MRLC-3	Moisture Resistance Test
High Temperature-Low Temperature Test Chamber	Associated Testing Lab Model 2LH-8-LC	Moisture Resistance Test
Salt Spray Chamber	Industrial Filter & Pump Mfg. Co. Model CA-3	Salt Spray Test

IV CONCLUSIONS

Qualification testing was completed on the preproduction samples. The units have passed all the required tests of SCS-242 and MIL-C-39020 Table III.

V PROGRAM FOR NEXT INTERVAL

1. Present quality control manual based on the techniques used in the fabrication of the preproduction samples.
2. Establish pilot line equipment and flow of material.

VI PUBLICATIONS AND CONFERENCES

No conferences were held during the reporting period of October to December.

VII MANHOURS EXPENDED

S. Cohen	130 hours
S. Greenzeig	80 hours
T. Gregory	100 hours
S. Wong	20 hours
R. Carbonaro	70 hours
J. Colindreler	100 hours

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13. ABSTRACT

Results obtained from the "Group 3" and "Group 4" environmental testing per Mil-C-39020 are presented.

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